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(54) BIAXIALLY ORIENTED POLYSTYRENE FILM

(57)Abstract:

PURPOSE: To prepare a biaxially oriented polystyrene film having few coarse protrusions on the surface and being excellent in transparency, slip, withstand voltage properties and abrasion resistance by mixing a specified surface-irregularity-forming agent with a surface modifier.

CONSTITUTION: This film is the one made from a syndiotactic polystyrene resin and containing inorganic and/or organic surface-irregularity-forming agents and a polystyrene-based surface modifier. It is desirable that the polystyrene resin has a syndiotactic structure of a diad fraction of 85% or above and a pentad fraction of 50% or above. It is desirable that the surface-irregularity-forming agent has a mean particle diameter of 0.01-2.0 μ m and that it is used in an amount of 0.005-0.2wt.% or above. An example of the surface modifier used is the one having a polystyrene skeleton which has an average molecular weight of 5000 or above and is modified with an iminium ion at one molecular end, and it is desirably used in an amount of 0.1-10wt.% based on the surface-irregularity-forming agent.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates to the syndiotactic polystyrene system biaxial oriented film excellent in a syndiotactic polystyrene system biaxial oriented film, still more detailed transparency slide nature suitable as the object for a package, the object for capacitors, a base film for magnetic tape, etc., a withstand voltage characteristic, and abrasion resistance.

[0002]

[Description of the Prior Art]A syndiotactic polystyrene system biaxial oriented film is excellent in heat resistance, an electrical property, transparency, etc., and deployment is expected from various kinds of film applications, such as magnetic tape, a photograph and the object for platemaking, an object for capacitors, and an object for a package. When used as these uses, the slide nature and abrasion resistance are a major factor which influences the quality of the workability of the manufacturing process of a film, or a work process. On the other hand for these uses, it is required strongly that it should be smooth in a film surface and transparency should be good or thin. However, in a syndiotactic polystyrene system biaxial oriented film, The surface was only smoothed and the wear-resistant defect of being generated by an abrasion, the face powder twisted for the ability to delete, etc. was woken up by the rarefaction or the poor slide nature by contact with the guide roll at the time of the defect of the handling characteristics at the time of manufacture of a film, and processing, and a film run, etc. if it became thin. A syndiotactic polystyrene system biaxial oriented film is weak, it is easy to generate a void around the lubricant added for slide nature grant, and the fall of transparency is seen. Lubricant is easily omitted by generating of this void, and **** at the time of a film run increases.

[0003]As a good film of slide nature, inorganic lubricant is added, surface roughness Ra is in the specific range, and that to which the coefficient of static friction was limited is known. (JP,3-74437,A)

[0004]

[Problem(s) to be Solved by the Invention]However, also in a film with the above-mentioned conventional good slide nature, although good handling characteristics were acquired at the time of low-speed work, when work became high-speed, there was a problem that handling characteristics got worse rapidly. In a syndiotactic polystyrene system biaxial oriented film, The tendency for handling characteristics to get worse if especially the thickness of a film becomes thin is large, Even if the above-mentioned inorganic particle was added, and it has the same tendency also in the film which specified the range of surface

roughness Ra and a coefficient of static friction, therefore good handling characteristics are acquired, if thickness changes, desired handling characteristics will not be acquired. It turned out that a syndiotactic polystyrene system biaxial oriented film is weak, it is easy to generate an abrasion, face powder, etc. in a film surface by friction with a roll etc. at the time of manufacture of a film, and processing, and there is a problem that abrasion resistance is poor. It becomes easy to generate a void around the lubricant added in order that the brittleness of this syndiotactic polystyrene system biaxial oriented film might become a cause and might make slide nature good, and, as a result, is easy to produce problems, such as a fall of transparency, and an increase which can be deleted. The film obtained by condensation of the added lubricant taking place had many big and rough projections, and those particles dropped out easily and had become the cause that abrasion resistance is poor.

[0005]By this invention's controlling condensation of the lubricant particle in the inside of a film, and controlling generating of a coarse particle, Exfoliation by lubricant of an inorganic system and/or an organic system and the interface of a syndiotactic polystyrene system polymer is controlled, there is no big and rough projection, and it aims at providing the syndiotactic polystyrene system biaxial oriented film excellent in transparency, slide nature, a withstand voltage characteristic, and abrasion resistance.

[0006]

[Means for Solving the Problem]A syndiotactic polystyrene system biaxial oriented film of this invention, With a film produced by containing a surface unevenness formation agent (it is called lubricant below) of an inorganic system and/or an organic system, and a polystyrene system surface modifier, and producing a film, a film surface has few big and rough projections, and it excels in transparency, slide nature, a withstand voltage characteristic, and abrasion resistance.

[0007]Tacticity used for this invention a polystyrene system polymer which is syndiotactic structure, It is desirable for tacticity by which a phenyl group or a substituted phenyl group which is a side chain is quantified with a nuclear magnetic resonance method to be not less than 50% of syndiotactic structure at die ADDO (a constitutional unit is two pieces) in not less than 85% and a pentad (a constitutional unit is five pieces).

[0008]As this polystyrene system polymer, polystyrene, poly (p-, m-, or o-methylstyrene), (2,4 -, 2,5 -, 3,4 -, or 3,5 - dimethylstyrene), Poly, such as poly (p-tertiary-butylstyrene) (alkyl styrene), Poly (p-, m-, or o-chlorostyrene), poly (p-, m-, or o-bromostyrene), Poly, such as poly (p-, m-, or o-fluorostyrene) and poly (o-methyl p-fluorostyrene) (halogenation styrene), Poly, such as poly (p-, m-, or o-chloromethyl styrene) (halogenation alkyl styrene), Poly (p-, m-, or o-methoxy styrene), poly (p-, m-, or ethoxystyrene), Which poly (alkoxy styrene), poly (p-, m-, or o-carboxymethylstyrene), poly (alkyl ether styrene), such as which poly (carboxy alkyl styrene) and poly (p-vinylbenzyl propyl), and poly (p-trimethylsilyl styrene) -- poly (vinylbenzyl dimethoxyphosphide) etc. are mentioned further.

[0009]Especially in this invention, polystyrene is preferred in said polystyrene system polymer. A polystyrene system polymer which has the syndiotactic structure used by this invention, It is not necessary to be necessarily a single compound, and as long as the Sindi nerd city city is said within the limits, a mixture field, copolymers, and those mixtures with a polystyrene system polymer of atactic structure and isotactic structure may be sufficient.

[0010]Weight average molecular weight of a polystyrene system polymer used for this invention is 50,000 or more still more preferably 10,000 or more. Weight average molecular weight cannot obtain a biaxial

oriented film excellent in the strong ductility characteristic or heat resistance in less than 10,000 thing. It is 1,500,000, although it is limited and is not especially a thing about a maximum of weight average molecular weight. Since generating of a fracture accompanying an increase in extension tension, etc. arise above, it is not so desirable.

[0011]As lubricant of an inorganic system and/or an organic system used for this invention, For example, silica, a titanium dioxide, talc, kaolinite, a silicon dioxide, Organic compound particles, such as inactive inorganic compound particles, such as alumina, calcium carbonate, calcium phosphate, barium sulfate, and calcium fluoride, bridge construction polystyrene, bridge construction polymethacrylic acid ester, and bridge construction polyacrylic ester, are illustrated. A non-crosslinked polymer, for example, polyester, polyamide, polyolefine, polyphenylene SAFAIDO, etc. are contained. Any one sort may be independently used for these lubricant, and it may use two or more sorts together.

[0012]Mean particle diameter of lubricant of an inorganic system added by syndiotactic polystyrene system polymer in this invention and/or an organic system is 0.01 micrometers or more. 2.0 micrometers or less, It is especially 0.05 micrometers or more. 1.5 micrometers or less are preferred and an addition receives 100 % of the weight of syndiotactic polystyrene system polymers. It is preferred to contain 0.005 to 2% of the weight, and it is especially 0.1-0.8. Weight % is preferred. In mean particle diameter, less than 0.01 micrometer or an addition. Since the slide nature of a film becomes insufficient at 0.005 or less % of the weight, it is not desirable. Mean particle diameter is 2 micrometers. Or if an addition exceeds 2 % of the weight, a void occurs in a film surface, a big and rough projection is produced, and it is not desirable in respect of a fall of the transparency of a film, face powder generating depended for the ability to delete at the time of a run, a fall of a withstand voltage characteristic, etc.

[0013]A polystyrene system surface modifier added by the above-mentioned lubricant in this invention is the average molecular weight 5,000, for example. It had the above polystyrene skeleton, conversion of the monad end was carried out with iminium ion, and ZEOFAIN BV by Nippon Zeon Co., Ltd. is raised. It can ** a chemical reaction arising between the lubricant surface of particles, and iminium ion, preventing condensation of lubricant to a molecular terminal, and receiving it distribution by introducing iminium ion. Since matrix resin is a syndiotactic polystyrene system polymer, this surface modifier has especially an effective modifier with a polystyrene skeleton, and an average molecular weight of the skeleton is 5,000. The above is preferred. An average molecular weight is 5,000. In the following, there is a possibility of spoiling the strong ductility characteristic and heat resistance of a film, and it is not desirable. As for an addition of this modifier, 0.1 to 10 % of the weight is preferred to lubricant, and its 0.5 to 5 % of the weight is especially preferred. A desired effect cannot be expected in 0.1 or less % of the weight, and there is no increase of an effect at 10 % of the weight or more.

[0014]What blended a proper quantity of publicly known antioxidants, sprays for preventing static electricity, etc. can be used for a syndiotactic polystyrene system polymer used for this invention if needed. Loadings are the syndiotactic polystyrene system polymer 100. Ten or less % of the weight is desirable to weight %. Since it will become easy to cause a fracture at the time of extension and will become poor [production stability] if ten weight sections are exceeded, it is not desirable.

[0015]A syndiotactic polystyrene system biaxial oriented film of this invention, Extension methods, such as length, width and the vertical extending method, width, length and the vertical extending method, length, length, a lateral orientation method besides [which performs a publicly known method for example, vertical

extension, and lateral orientation in order] a serial biaxial extension method, can be adopted, and it is chosen according to various characteristics demanded, such as intensity and dimensional stability. Heat setting processing, vertical relaxation processing, horizontal relaxation processing, etc. can be performed. [0016] Although an example explains this invention concretely below, this invention is not limited only to these examples. A valuation method of an obtained syndiotactic polystyrene system biaxial oriented film is shown below.

(1) Use a surface smoothness surfboard COM 300A molding surface roughness gauge (Tokyo Seimitsu), and it is a needle diameter of 1 micrometer. It displayed by arithmetical mean deviation of profile (R_a , μm) measured on load of 0.07 g, metrics length of 0.8 mm, and conditions of 0.08 mm of cutoff.

[0017] (2) After vapor-depositing aluminum thinly on the number film of big and rough projections of a film surface, using a two-beam-interference microscope, an interference fringe counted the four-fold or more number of big and rough projections (number per 1 mm of measuring-plane product 2), and ranked with some of numbers of big and rough projections.

more than the class [1st]; 16 piece [mm] 2 --; with a; with a; with the class [2nd]; 12-15 piece [mm] 2 of the class [3rd] 8-11 piece [mm] 2 of the class [4th] 4-7 piece [mm] 2 of the class [5th] 0-3 piece

[mm] 2 [0018] (3) Carry out the slit of the processability film of a film to a narrow width, and it is considered as tape shape, Rubbed this to metal guide rolls, are a high speed and it was made to run for a long time, and five steps were evaluated and some of white powder volume generated on size of tape tension after this guide roll scratch and the surface of a guide roll was ranked, as shown below, respectively.

(**) 1st [slide nature] class; -- tension -- a large (an abrasion -- there are many)

2nd class; -- **** -- a little -- a large (an abrasion -- remarkable -- there are many)

The 3rd class; inside of tension (hello an abrasion and **)

4th class; -- **** -- a little -- small (with none of most abrasions)

The 5th class; tension smallness (with no abrasion generating)

(**) 1st [wear-resistant] class; -- generating of face powder -- extraordinary -- generating of many 2 class; face powder -- generating of many 3 class; face powder -- hello, with no generating **** of ** 4 class; face powder -- with no generating of 5 class; face powder [0019] (4) Durable performance traverse was

measured using a device shown in durable performance-traverse drawing 1. the load 9 passing along the free roll 8, the tension test equipment 7, and the free roll 6 at the end of a tape, and at it attachment ** and this tape with reference to drawing 1. The commercial VTR guide pin 5 was contacted, it passes along the free roll 4, the tension test equipment 3, and the free roll 2, the crank 1 was rotated, a tape was contacted to a commercial guide pin, and durable performance traverse was measured. A measuring condition was performed under atmosphere of temperature of 23 **, and 65% of relative humidity. A film is contacted to a commercial VTR guide pin at the angles $3/4\pi$ (a unit radian), evaluating and ranking increment ($\Delta\mu_{mk}$ and $\Delta\mu_{ms}$) from a dynamic friction coefficient at a time of giving tension of 50 g of constant load, rotating a crank at 8.0 rpm, and making a film go back and forth 100 times, each initial dynamic friction coefficient of a coefficient of static friction, and a coefficient of static friction -- a table -- the bottom. As a commercial VTR guide pin, the maximum projected height measured with a tracer type surface roughness meter is 0.15 micrometer. What is 0.008 micrometers of arithmetical mean deviation of profile was used. Less than [the class / 1st /; the coefficient-of-friction increment / or more 0.2 / 2nd class /; the class / 0.15-

0.203rd /; the class / 0.10-0.154th /; the class / 0.05-0.105th /;] 0.05 [0020](5) According to light transmission JIS-K6714, it asked for light transmission of a film with Japan precision optical incorporated company make POIKKU integrating sphere type HTR meter SEP-H2D type.

(6) It carried out according to withstand voltage JIS-C2318. A 10-kV direct-current withstand voltage test machine was used, and voltage when a film broke and short-circuited at 100 kv/sec pressure-up speed under atmosphere of 23 ** and 50%RH was read.

[0021]As Example 1 and 2 lubricant, 1.1-micrometer spherical silica (example-1), 2% of the weight of a surface modifier (ZEOFAIN BV, Type 02, molecular weight 17×10^3 , Nippon Zeon Co., Ltd. make) was added to these lubricant using the 1.1-micrometer bridge construction polystyrene (example-2) which consists of styrene, divinylbenzene, and methacrylic acid. Used syndiotactic polystyrene was weight-average-molecular-weight 30×10^4 , and was nearly perfect syndiotactic structure. This polymer was dried, and it fused at 295 **, and extruded from a T die, adhesion and cooling solidification made it a 40 ** cooling roller by the electrostatic **** method, and a 120-micrometer formless sheet was obtained. Preheat this formless sheet at 100 ** with a roll first, and it heats further, using an infrared heat heater with a skin temperature of 800 ** three, film temperature of 135 ** -- a lengthwise direction -- a 3.6 time extension child -- succeedingly, a film was extended at 120 ** by a tenter, it extended 3.3 times at extension temperature of 120 ** in a preheating child and a transverse direction, and heat setting was carried out at 260 **. Thickness of an obtained film was 10 micrometers.

[0022]A film was adjusted with same method as Example 1, without adding a surface modifier, using 1.1-micrometer spherical silica as comparative example 1 lubricant. It combines with an example and is shown below.

[0023]

[Effect of the Invention]As mentioned above, when this invention adopts the composition as a statement as said claim as a statement, There is little condensation of the lubricant particle in a film, the syndiotactic polystyrene system biaxially oriented film which was excellent in transparency and slide nature with few big and rough projections, and abrasion resistance in the film surface is provided, therefore industrial worth of this invention is size.

[0024]

[Table 1]

	実施例 1	実施例 2	比較例 1
滑剤種類	シリカ	架橋シリカ	シリカ
粒径 (μm)	1.1	1.1	1.1
添加量 (ppm)	2000	2000	2000
表面粗さ; R a (μm)	0.025	0.022	0.027
粗大突起数 (級)	5	5	5
滑り性 (級)	5	5	5
耐摩耗性 (級)	5	5	3
Δμsd (級)	4	5	3
Δμkd (級)	4	5	3
透明性 (%)	90	94	84
耐電圧 (V/μm)	540	550	480

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CLAIMS

[Claim(s)]

[Claim 1]A polystyrene system biaxial oriented film containing a surface unevenness formation agent of an inorganic system and/or an organic system, and a polystyrene system surface modifier in a biaxial oriented film which consists of syndiotactic polystyrene system resin.

[Claim 2]The polystyrene system biaxial oriented film according to claim 1, wherein conversion of the molecular terminal of the polystyrene system surface modifier according to claim 1 is carried out with iminium ion.

[Claim 3]The polystyrene system biaxial oriented film according to claim 1, wherein content of the polystyrene system surface modifier according to claim 1 is 0.1 to 10 % of the weight to a surface unevenness formation agent.

[Translation done.]